

## **Residual CRT Glass Management and the CEW Recycling Payment System**

### Summary:

In 2001, when the Department of Toxic Substances Control (DTSC) clarified that cathode ray tube (CRT) devices were in fact considered hazardous when disposed, recycling markets existed for recovered residual CRT glass. Although the cost of device recovery and processing typically exceeded the combined value of the glass and other residuals (resulting in a “net cost” to recycle this technology), there were readily available options to send CRT glass either toward new CRT manufacturing or toward lead smelting. While never a cheap material to handle, properly sorted and cleaned residual CRT glass reportedly could be sold for between \$100 and \$200 per ton to CRT manufacturers, and smelters would accept leaded glass at a nominal cost for use as a flux.

Just over a decade later, CRT technology is no longer being consumed in any appreciable amount in the developed world. The sole manufacturer of new CRTs accepting processed glass from the West is located in India and is charging between \$100 and \$200 per ton to do so. Reportedly only three large metal smelters in North America will accept CRT glass in quantity and at a price, though new lead extraction technologies for high-lead content funnel glass are allegedly being developed on smaller scales. Non-leaded and low-leaded panel glass, which contains barium for radiation shielding, continues to look for a viable large-scale application.

California’s covered electronic waste (CEW) recycling program has generated an average of approximately 100 million pounds of residual CRT glass annually since it began operation in 2005. A key component of that program has been a requirement that the derived CRT glass be “shipped” to a destination authorized to further treat that material, under the assumption (and implicit hazardous waste management requirement) that the material would eventually find an appropriate recycling application. This workshop is intended to revisit assumptions, examine market realities, assess policies, and explore whether the regulations under which the CEW program currently operates need to be adjusted.

### Background:

Soon after the enactment of the Electronic Waste Recycling Act of 2003 (Act) via the passage of SB 20, CalRecycle’s predecessor, the California Integrated Waste Management Board (CIWMB), proposed draft regulations to implement the covered electronic waste (CEW) recovery and recycling payment system. The proposed regulations established claim eligibility requirements that included criteria for the management of treatment residuals derived from processed CEW. In order for a recycler to submit a payment claim for recycling CEW that contained cathode ray tubes (CRTs), derived residual CRTs or CRT glass must have been shipped to a destination authorized to receive and further treat that

material. In fact, for administrative documentation reasons, the initial proposed regulations based the recycling payment claim on the weight of the shipped glass multiplied by a payment rate factor that depended on the degree of residual glass processing.

SB 50 amended the Act in 2004, prior to the promulgation of the original proposed regulations, and required the CIWMB to pay on the full weight of CEW recovered and cancelled (see PRC 42478(b)), establishing a clear distinction between CEW recycling and residual CRT glass management. However, regulations continued to condition submittal of recycling payment claims on the shipment of residual glass and, in part due to a 2006 market disruption involving a major lead smelter, were soon amended to clarify that all CRT glass derived from the processing (cancellation) of CEW must be shipped prior to submitting a recycling payment claim for that CEW.

There were several reasons for establishing residual CRT glass management criteria within the CEW recycling system rules. Residual CRTs and CRT glass, while no longer CEW, remain a regulated hazardous waste. While the ultimate disposition of the residual CRTs and CRT glass would occur in a timeframe and location far beyond the necessary scale of recycling claim cycles, this shipping requirement was deemed prudent to ensure that the CRT material was in fact moving toward a disposition allowable under California universal waste rules, the regulatory framework within which the majority of the program participants operate. Furthermore, the shipment of glass provided certified weight documentation that could act as an additional proxy measure for the original amount of CEW being claimed for recycling payment.

In addition to the CRT shipping criteria, CEW recycling claimants are also required by regulation to submit as part of a claim “... a discussion of the ultimate disposition of the (CRT) material shipped demonstrating that the disposition is not disposal to land, water or air.” This requirement was again intended to be supportive of the foundational hazardous waste regulatory framework, specifically universal waste rules, under which material collection, transportation, and treatment typically occurred. Any and all “ultimate dispositions”, it must be noted, have not “ultimately” been in California.

#### Program Experience:

Universal waste management rules applicable to CRT glass handling and treatment have generally recognized new CRT manufacturing (“glass-to-glass”) and lead smelting as the only appropriate recycling dispositions for CRT glass. However, neither of these ultimate end-uses occurs within the state of California. Early program participants generally shipped glass to North American smelters or to glass processors for beneficiation prior to subsequent marketing to overseas CRT manufacturers. As more volume of CEW was recovered and processed, a larger proportion of derived CRT glass was ostensibly sent toward the so-called “glass-to-glass” market (e.g. CRT manufacturing), either directly or

through processors. This practice was influenced by accessibility and price, even as the global production and sale of CRT devices rapidly declined.

By mid-2009, approximately 75% of residual CRTs and/or CRT glass was being shipped to Mexican processors. However, in the 4<sup>th</sup> quarter of 2009, access to Mexican CRT glass processors was interrupted for nearly a year. Because CEW recyclers were required to ship CRT glass to a destination “authorized to receive and further treat” the glass prior to filing CEW recycling claims, this interruption caused the volume of claimed CEW to decrease dramatically while recyclers searched for alternative outlets for CRT glass. A couple of recyclers pursued establishing their own in-state CRT processing capabilities, while other enterprises started or offered capacities out-of-state.

The requirement to “ship” CRT glass had been interpreted by CIWMB (now CalRecycle) as meaning that the glass be moved offsite from the facility where the CEW was cancelled and the treatment residual generated. This interpretation was supportive of universal waste accumulation time limits. As access to ultimate disposition became more uncertain, and as the price charged by out-of-state processors increased, more recyclers pursued interest in establishing their own in-state, off-site processing capabilities (or at least authorizations) to fulfill shipping criteria. While this would allow CEW recycling payment claims to be submitted with regularity, it did not necessarily create new markets for CRT glass.

#### Current Situation:

CalRecycle understands that current markets for residual CRTs and CRT glass are limited. Access to traditional lead smelting is reportedly difficult, with only one facility in the U.S. (Doe Run, Missouri) and two in Canada (Teck Cominco and Xstrata) known to accept CRT glass in volume. Furthermore, traditional smelting does not recover all lead from CRT glass effectively and results in hazardous slag wastes that must be subsequently managed. There remains one known CRT manufacturer available to receive glass from the West (Videocon, located in India); however, given that the residual CRT glass derived from numerable nations’ recycling efforts are also competing for an outlet, reliable access to and the longevity of this market for California recyclers is uncertain.

As of January 2013, over 300 million pounds of residual CRTs and CRT glass had been shipped by CEW recyclers since January 2010. At the same time, though, substantial reduction in destination options occurred over these last three years, particularly to out-of state and foreign locations. With the exception of Doe Run (smelter) and Samtel Glass / Videocon Industries (the CRT manufacturer in India), all out-of-state destinations that received shipments in 2012 are not ultimate endpoints; instead, they are intermediate facilities that possibly perform some degree of CRT processing before presumably shipping the glass onto a subsequent destination or ultimate disposition.

The following table (Table 1) is a summary of initial residual CRT/CRT glass shipment destinations and quantities (in millions of pounds as of January 2013), derived from documentation contained in CEW recycling payment claims. The table presents shipments in all three years since January 2010 as well as just those shipments since January 2012. Note that data for 2012 may be incomplete due to a time-lag in receiving CEW recycling payment claims. Also note that a small number of incidental shipments amounting to less than 0.1% of total volumes shipped are not accounted for here.

**Table 1: Initial Residual CRT and CRT Glass Shipping Destinations (in millions of pounds)**

Initial Destination	Since January 2010	Since January 2012
<b><u>In-State*</u></b>		
ECS Refining / Regenesys Glass (Stockton)	22	17
Electronic Recyclers International (Fresno)	41	8.5
e-Recycling of California (Irvine)	51	13
E-World Recyclers (Vista)	1	< .5
PC Recycle (Newbury Park)	< 4	1.5
<b><u>Out-of-State</u></b>		
Closed Loop Refining and Recovery (Arizona)	74	26
Com2 Computer & Technology (Illinois)	< 1	
Dlubak Glass (Arizona, Ohio)	34	
Doe Run (Missouri)	< 1	
Dow Management (Arizona)	6	6
Universal Recycling Technologies (Oregon)	4	
<b><u>Foreign</u></b>		
Hankuk Electric Glass (Korea)	< 2	
Samsung Corning (Malaysia)	< 2	
Samtel Glass / Videocon Industries (India)	7.5	5
Technologies Displays Mexicana (Mexico)	58	26

*\*All listed in-state destinations are ostensibly authorized to treat CRTs under 22 CCR 66273.73 and may accumulate CRTs and/or CRT glass for up to one year under universal waste rules before presumably being shipped onto another appropriate destination.*

#### New CRT Management Regulations

On October 15, 2012, DTSC issued emergency regulations governing the management of CRTs and CRT glass. The new rules established stricter specificity on how in-state handlers are regulated depending on the ultimate disposition of this material. The rules preserve the ability of handlers who simply collect and dismantle CRT devices to operate under the universal waste framework. The rules also maintained pathways for CRTs and CRT glass to be shipped and ultimately recycled through traditional markets (smelting and CRT manufacturing) under the universal waste framework.

Perhaps the most significant changes in the rules created the allowance for CRTs and CRT glass to be ultimately managed via alternative recycling applications, if such applications exist, without necessarily jeopardizing the upstream handling and treatment of CRT devices and CRTs under the universal waste concept. These changes even opened up the possibility of, and specified the standards for, regulated disposal for CRT glass should feasible markets be unavailable.

It must be noted again that the CEW recycling program regulations are separate from, though constructed upon, the rules that govern the physical management of residual CRTs and CRT glass. However, although now afforded the possibility of residual CRT disposal under DTSC's new CRT rules, the current CEW program rules continue to require recyclers to "ship" residual CRTs and CRT glass for purposes other than disposal to land, air, or water. Unless and until that changes, CEW recyclers must continue to search for what appear to be elusive and diminishing residual CRT glass recycling options.

#### Looking Ahead:

CRT glass can be categorized into leaded glass and non-leaded glass. Sometimes this is referred to as "funnel glass" and "panel glass", but such classification can be misleading since a portion of panel glass also contains lead. And even so-called non-leaded glass contains other metals, such as barium, at levels that create environmental and regulatory concern, particularly under California hazardous waste law. The ability to effectively identify, separate, characterize, and process CRT glass will be critical to future management options.

New lead extraction technologies reportedly are emerging that are more efficient than traditional smelting, including three facilities (in AZ, TX, and NY) utilizing new technologies that are in differing stages of development but not yet at production-scale operation. Alternative applications also have been reported for non-leaded CRT glass, such as in building materials, insulation, aggregate, proppant, industrial abrasives, reflective coatings, and fill. However CalRecycle is not aware of any alternative production-scale applications in the United States that have been demonstrated to and evaluated by DTSC and found to constitute an ultimate disposition that would warrant inclusion in the list of uses allowed under universal waste rules.

As the CEW recycling system moves forward, consideration should be given to the availability of viable CRT glass markets and alternatives, the anticipated lifespan of those markets and the available supply of feedstock, and the environmental impacts associated with moving the glass to those markets versus other management options. The fact that the ultimate disposition of essentially all residual CRT glass currently occurs beyond California's borders, and in a timeframe that makes the effective monitoring of that disposition problematic, suggests policies that ensure more certain fates closer to home should be considered.

## Workshop Discussion

The following questions and topics will be among those posed to participants at the stakeholder workshop. Participants are encouraged to raise their own issues of regulatory interest or concern within the context of the CEW recycling program as currently provided for by the Electronic Waste Recycling Act.

- CRT Markets:
  - What are the current major barriers to finding viable markets for residual CRT glass?
  - What is your response to recent allegations of North American stockpiles?
  - How much CRT glass remains to be recovered and managed, and how long will this last?
  - What is your prognosis for the longevity of current markets for residual CRT glass?
  - What is the outlook for new or emerging CRT recycling markets / technologies?
  - What role or influence do third-party certification programs play in residual CRT glass management decision making?
- Industry Economics:
  - What are the most significant drivers affecting the cost of CRT downstream options?
  - Why does it currently cost so much to market CRT glass if it is a viable commodity?
  - If processed CRT glass has value, shouldn't that alone outcompete disposal?
- Program Administration:
  - Assuming otherwise compliant management under rules administered by DTSC, can and/or should CalRecycle attempt to monitor the flow and ultimate fate of residuals in a global marketplace? To what extent?
  - How would a revised CEW recycling payment system take into account varying dispositions of residuals, including the possibility of residual disposal? Should it?